Research Problem Review 79-8

LEVEL II

AD A076638

ORGANIZATIONAL MAINTENANCE PERFORMANCE

J. Douglas Dressel
and
Joyce L. Shields, Team Chief

TRAINING TECHNICAL AREA

DDC
RECEIVED
NOV. 16 1979
A

DDC FILE COPY

U. S. Army
Research Institute for the Behavioral and Social Sciences

April 1979

79 11 15 280

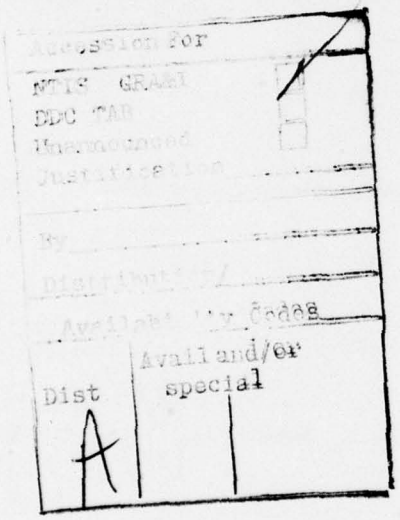
Approved for public release; distribution unlimited.

U. S. ARMY RESEARCH INSTITUTE
FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency under the Jurisdiction of the Deputy Chief of Staff for Personnel

JOSEPH ZEIDNER
Technical Director

WILLIAM L. HAUSER
Colonel, US Army
Commander



NOTICES

DISTRIBUTION: Primary distribution of this report has been made by ARI. Please address correspondence concerning distribution of reports to: U. S. Army Research Institute for the Behavioral and Social Sciences, ATTN: PERI-P, 5001 Eisenhower Avenue, Alexandria, Virginia 22333.

FINAL DISPOSITION: This report may be destroyed when it is no longer needed. Please do not return it to the U. S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

Army Project Number
2Q162722A777

Performance-Based
Training

Research Problem Review 79-8

ORGANIZATIONAL MAINTENANCE PERFORMANCE

J. Douglas Dressel

Joyce L. Shields, ~~Team Chief~~

17

Submitted by:
Milton S. Katz, Chief
TRAINING TECHNICAL AREA

Apr 79

ARI-RES PROBLEM REV-79-8

Approved by:

E. Ralph Dusek, Director
Personnel and Training Research
Laboratory

Joseph Zeidner, Technical Director
U.S. Army Research Institute for the
Behavioral and Social Sciences

Research Problem Reviews are special reports to military management. They are usually prepared to meet requirements for research results bearing on specific management problems. A limited distribution is made--primarily to the operating agencies directly involved.

408 010 (A)

FOREWORD

The Training Technical Area of the Army Research Institute for the Behavioral and Social Sciences (ARI) conducts a program of research in support of the systems engineering of training. A major part of this research is to develop the fundamental data and technology necessary to put into the field integrated systems for improving individual job performance. Such systems include Skill Qualification Testing (SQT), job performance aids, training courses in schools and in the field, performance criteria, and management and feedback systems.

This report presents data on organizational-level maintenance performance of a brigade-sized unit. The data collection technique can be used to evaluate new systems of maintenance training.

The work was accomplished under Army Project 2Q162722A777, Individual Training Technology; the entire project is supportive of programs of interest to the Training Developments Institute of the Training and Doctrine Command (TRADOC).

JOSEPH ZEIDNER
Technical Director

ORGANIZATIONAL MAINTENANCE PERFORMANCE

BRIEF

Requirement:

To determine any change in performance brought about by a new system of maintenance training, the level of performance under the old system must be assessed. This report presents a measure of organizational maintenance performance in a brigade-sized unit.

Procedure:

The repair actions performed on M551 turret end items at direct support level were recorded for 1 year. The data were derived from the Maintenance Request Form, DA 2407. On a monthly basis, the shop manager of a direct exchange facility at the direct support level forwarded computer-compatible data records to ARI for processing. Maintenance performance charts and tables were returned to the unit monthly.

Findings:

The nature and number of items turned in for repair varied greatly over the year, as a function of personnel turbulence and unit activity. The total rate of false removals was 42%. The measure of organizational maintenance performance was useful, easy to obtain, and compatible (i.e., did not interfere) with mission performance.

Utilization of Findings:

The technique for measuring organizational maintenance performance can be used and modified to evaluate new systems of maintenance training and to detect problems in operational maintenance units.

ORGANIZATIONAL MAINTENANCE PERFORMANCE

CONTENTS

LIST OF FIGURES

ORGANIZATIONAL MAINTENANCE PERFORMANCE

INTRODUCTION

The efficient maintenance of Army equipment is essential to combat readiness. The Army now has .71 systems per soldier of equipment and weaponry, excluding small arms.[1] As the complexity of equipment increases, the number of experienced maintenance personnel is decreasing; reenlistment rates for a second tour are low. New techniques of maintenance training are being developed to enable relatively inexperienced personnel to make an immediate contribution to the maintenance mission. To assess changes in performance brought about by such new methods of maintenance training, the level of performance under the old system must be determined.

PURPOSE

This report provides a method for measuring organizational-level maintenance performance in a brigade-sized unit and presents the findings from one unit during a 1-year period.

PROCEDURE

In one unit, end items from the M551 (Armored Reconnaissance Airborne Assault Vehicle) turret are submitted to a direct exchange shop for direct support maintenance. The number and condition of end items submitted by each organizational unit provide an indication of organizational maintenance performance. Each organizational unit submits a Maintenance Request Form, DA 2407, as the end item is turned in for exchange.

After consulting with the maintenance personnel of the direct exchange shop, ARI developed a coded computer-compatible data form (SF 77-1) based on the DA 2407 (see Appendix). The SF 77-1 identifies the end item, the submitting troop, the specific repair actions, and the repair times required. End items submitted for repair included generators, relay boxes, power supplies, and dimmer boxes. Common repair actions are installing, replacing, adjusting, inspecting, and testing. In addition, SF 77-1 provides for recording false removals, i.e., serviceable items submitted as unserviceable.

---

[1] Integrated Technical Documentation and Training (ITDT). Army Research, Development and Acquisition Magazine, July-August 1978, pp. 14-15.

After completing the DA 2407, the shop manager of the direct exchange facility completed an SF 77-1 for each repaired item. It took approximately 5 minutes to complete the SF 77-1. Once a month the shop manager forwarded these forms to ARI. The forms were processed, and maintenance performance charts and tables were returned to the unit.

RESULTS AND DISCUSSION

The data collected during the year can be analyzed in terms of (a) what was found and (b) what may have influenced the findings.

Maintenance Performance Data

Figure 1 shows the record of total submissions and false removals for the year. The fluctuation in number follows the yearly training cycle. The two submission peaks, during September through November and February through April, coincide with the periods of tank gunnery training. Increased turret use during firing exercises increases the probability of failure and the number of end items submitted for repair. Also, the crew is less likely to tolerate a turret malfunction during gunnery training when their performance is being evaluated. The peak false removal rate during March and April may reflect the substantial replacement of experienced with inexperienced mechanics during that period.

Figure 2 shows the percentage of total submissions for each principal end item and the proportion of those end items that were false removals. For example, 14.2% of all submissions were relay box submissions, and 72% of these were falsely removed. The items with the largest proportion of false removals were the relay box and servomotor. Organizational maintenance is responsible for determining if those items are serviceable. In troubleshooting many turret electrical problems, the mechanic is directed to the accessory and relay boxes. The high probability of failure and the difficulty of readily establishing the malfunction may induce some organizational mechanics to forward these items to direct support without complete examination. In the direct support shop, serviceability can be established more quickly with the aid of a complete testing bench.

An indication of the impact of false removals can be assessed in terms of dollar cost of equipment involved. Figure 3 gives the unit cost, the aggregate cost, and the portion of that aggregate cost caused by false removals for each of the most frequently submitted end items. The total cost of items submitted for repair was $1.24 million; false removals account for 29% of this total, or $360,000. As Figure 3 shows, some mistakes are more costly than others. For example, although only four periscopes were falsely submitted during the year, the cost of inventory was second only to that of the relay box, the most frequently submitted item (60 during the year). Additional

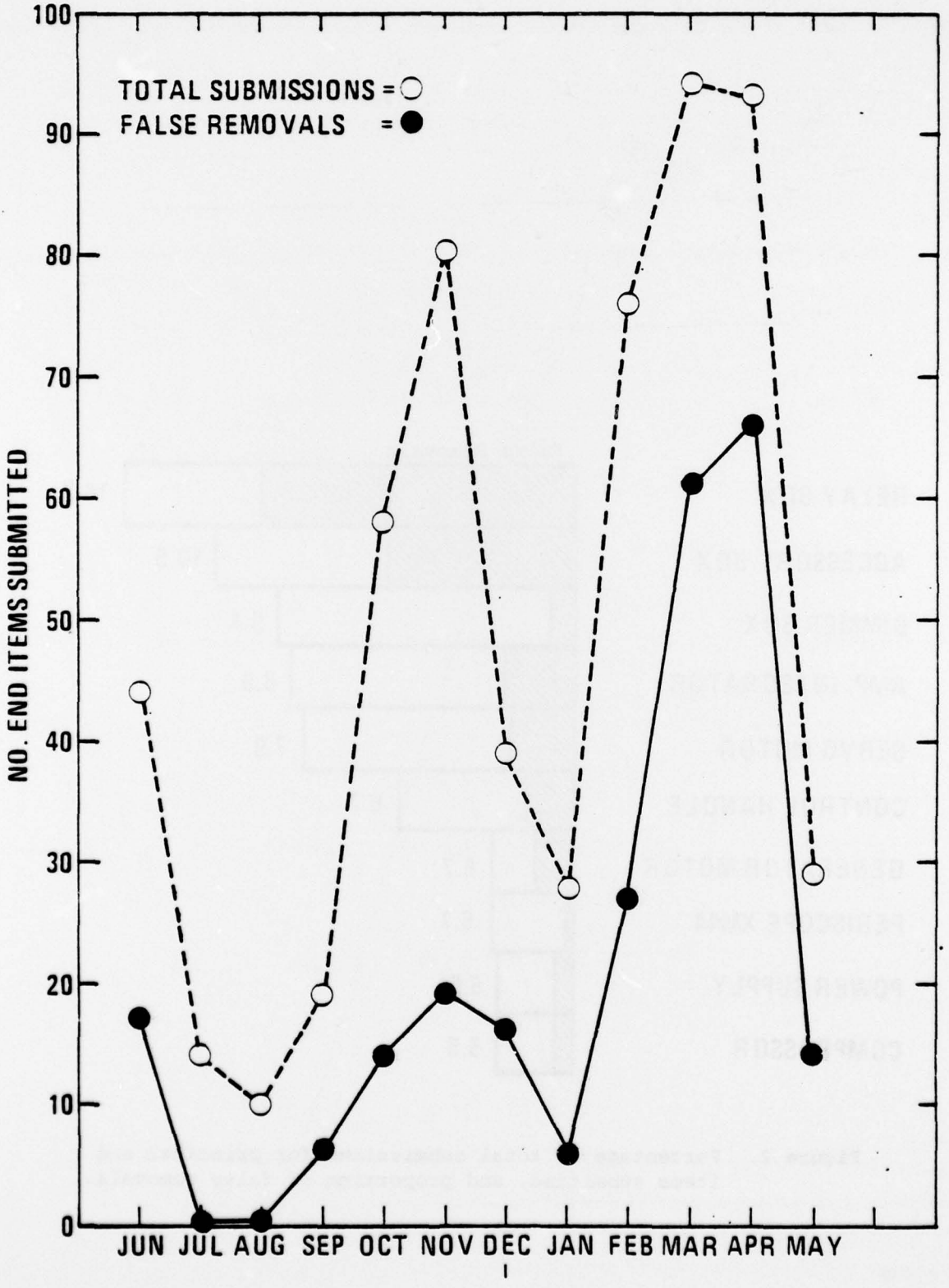


Figure 1. Number of items submitted for repair, by month

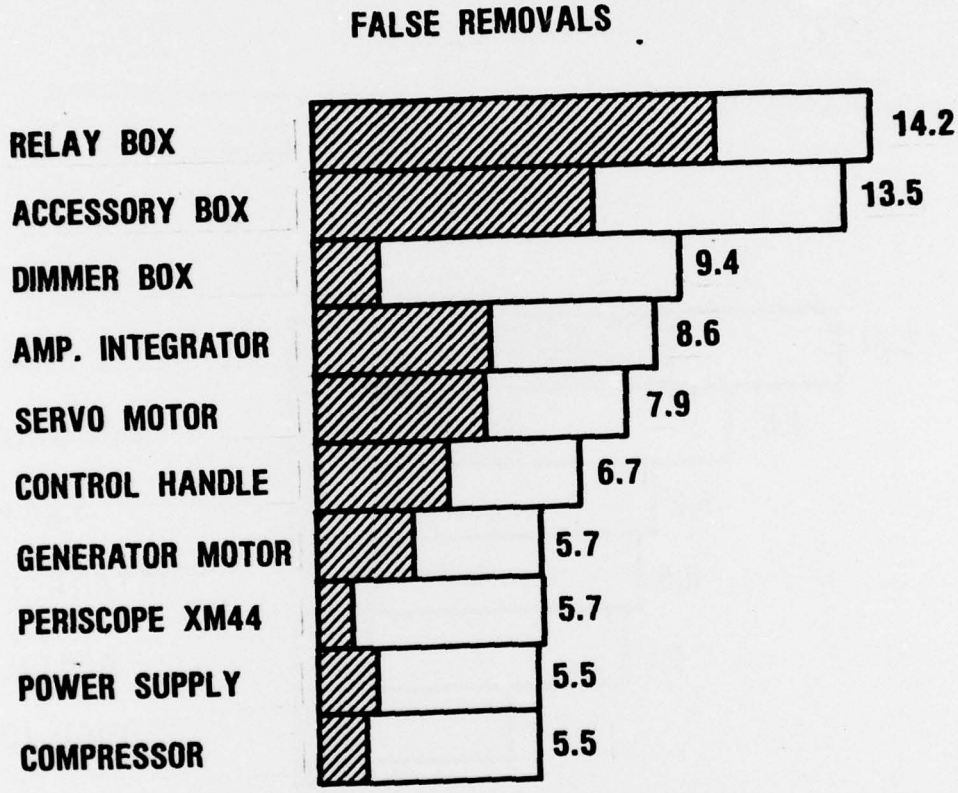


Figure 2. Percentage of total submissions for principal end items submitted, and proportion of false removals.

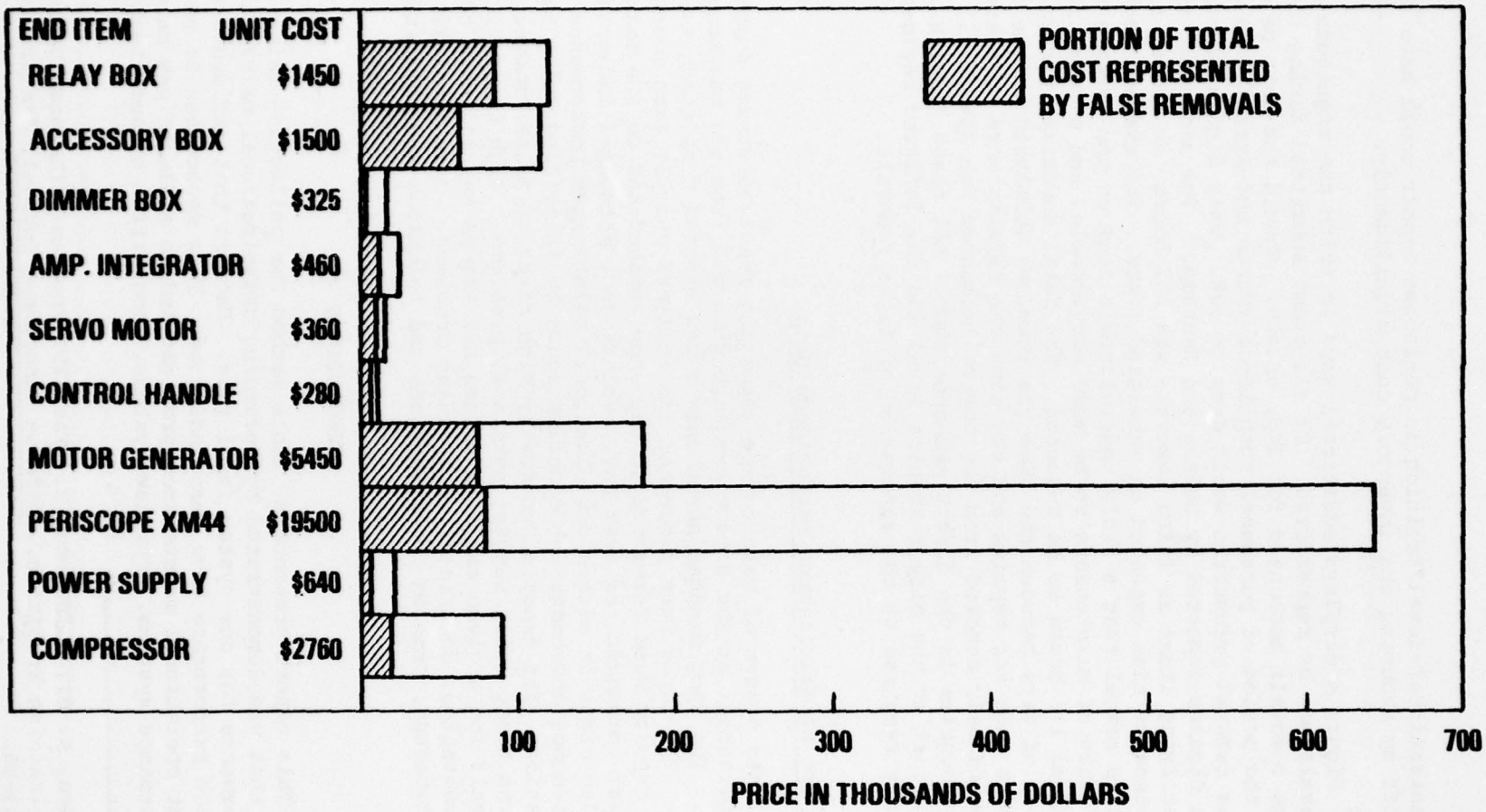


Figure 3. Total dollar cost of principal end items submitted.

organizational-level training in periscope repair could have a high payoff by reducing the inventory cost significantly.

Figure 4 displays additional ways in which the magnitude of false removals may be represented. Of all items submitted during the year, false removals accounted for 246, or 42%. Should the data be excluded for the period of personnel turbulence (March and April), the yearly false removal percentage would drop to 30%. This figure is consistent with figures reported by Buchan and Knutson.[2] The amount of time spent identifying items as false removals was 367 hours, or 32% of all the maintenance time expended on submitted items. The average repair-time figures reveal that a truly unserviceable item on the average required 2.3 hours of maintenance to be made serviceable, and a false removal required 1.5 hours to be detected. The total downtime represents the number of days between the time the item was submitted to the direct support shop for repairs and the time the repairs were completed. Items falsely removed from the turret accounted for 30% of all the item downtime in the direct exchange shop. All these figures indicate the effort at the direct support level and the inflated regimental inventory required by the submission of false removals.

Unit Use of Maintenance Performance Data

This system of maintenance reporting received strong support from the personnel at the direct exchange shop and from the maintenance company. The shop manager spent only a few minutes completing each SF 77-1. The forms were processed and analyzed quickly each month. Summary reports were forwarded to the shop manager and to the maintenance company commander the next day. Maintenance personnel indicated that problem areas in either organizational maintenance performance or maintenance documentation/doctrine could be identified using this information. For example, unusually high rates of false removals from a given troop would suggest personnel problems. High rates of false removals for a given end item across all troops may indicate technical documentation, doctrinal, or training problems. Once the indications are detected, problem determinations and solutions are initiated.

CONCLUSIONS

This report presents a viable method for collecting maintenance data that was demonstrated by recording organizational maintenance performance for one system for 1 year. Factors that influence maintenance performance have been indicated. This method can be used to detect operational maintenance problems and to evaluate new maintenance performance systems. For new systems, recognition of such factors as

---

[2] Buchan, R. S., & Knutson, R. The ITDT Program: The Army Departs from Training Tradition. Defense Management Journal, January 1977, pp. 33-36.

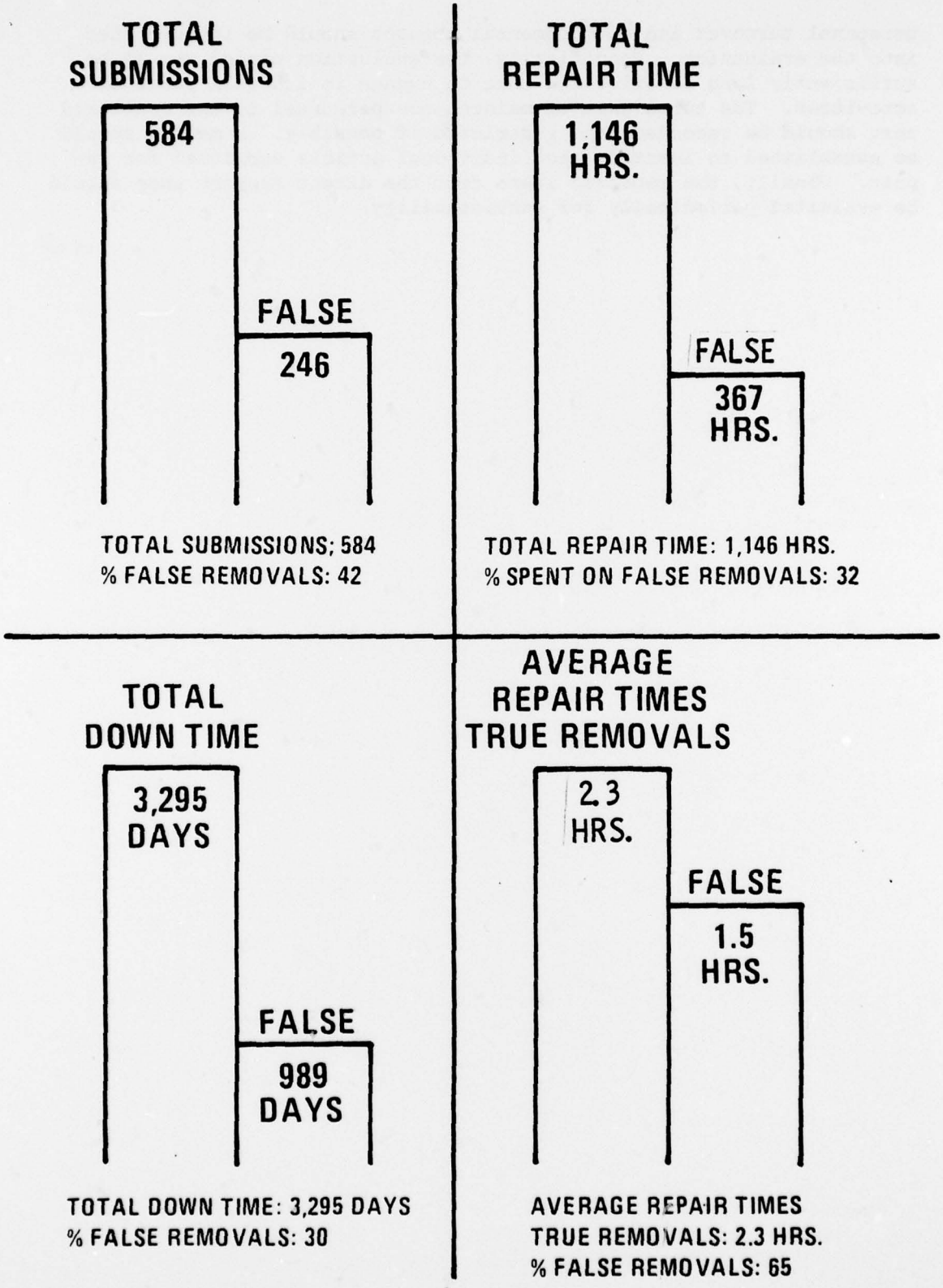


Figure 4. Effort expended on submitted end items.

personnel turnover and environmental changes should be incorporated into the evaluation. Specifically, the evaluation period should be sufficiently long to allow the unit to engage in its full range of activities. The turbulence of maintenance personnel in the monitored unit should be recorded, and restricted if possible. A method should be established to identify each individual article submitted for repair. Finally, the repaired items from the direct support shop should be evaluated periodically for serviceability.

APPENDIX

CODE SHEETS SF 77-1
FORM SF 77-1

DIRECT EXCHANGE

ARMAMENT AND MISSILE COMPONENTS

NUMBER	END ITEM	FSN
01	Accessory Box	1025-853-7572
02	Grenade Control Box	1025-844-4126
03	Relay Box	1025-089-4788
04	Compressor	4310-196-1617
05	Power Supply	1025-179-1316
06	Dimmer Box	1025-443-1006
07	Loader Box Assembly	1025-113-9663
08	T. C. Handle	1025-908-4125
09	Control Handle	2590-859-5972
10	Elevation Mech.	1015-999-4584
11	Amp. Integrater	1025-908-4113
12	Servo Motor	1025-916-9062
13	Filter Panel (Missile)	1430-923-6615
14	Chassis Assy. (Missile)	1430-116-6968
15	Starter Xmitter (Missile)	1430-923-6621
16	Traverse Mech. Comm. Coup.	1025-042-5190
17	Tracker (Missile)	1430-921-6445
18	Rate Sensor (Missile)	1430-947-6953
19	TOT (Missile)	4935-921-6481
20	Telescope M127	1240-437-1254
21	Xmitter (Missile)	1430-921-6447
22	Modulator (Missile)	1430-925-2627
23	Power Supply	1430-179-4065
24	Control Panel, IR	1240-915-5725
25	SDC (Missile)	1430-949-5489
26	Telescope M119	1240-762-9333
27	Telescope Mount M149	1240-762-9334
28	Emergency Reticle Box	1025-824-5496
29	Periscope XM44	1240-788-5463
30	Generator Motor	0125-916-9088
31	Telescope M127 & M127A	1240-148-8539
32	Power Supply, Grenade	1025-148-9073

UNIT

01
02
03
04
05
06
07
08
09
10
11
12

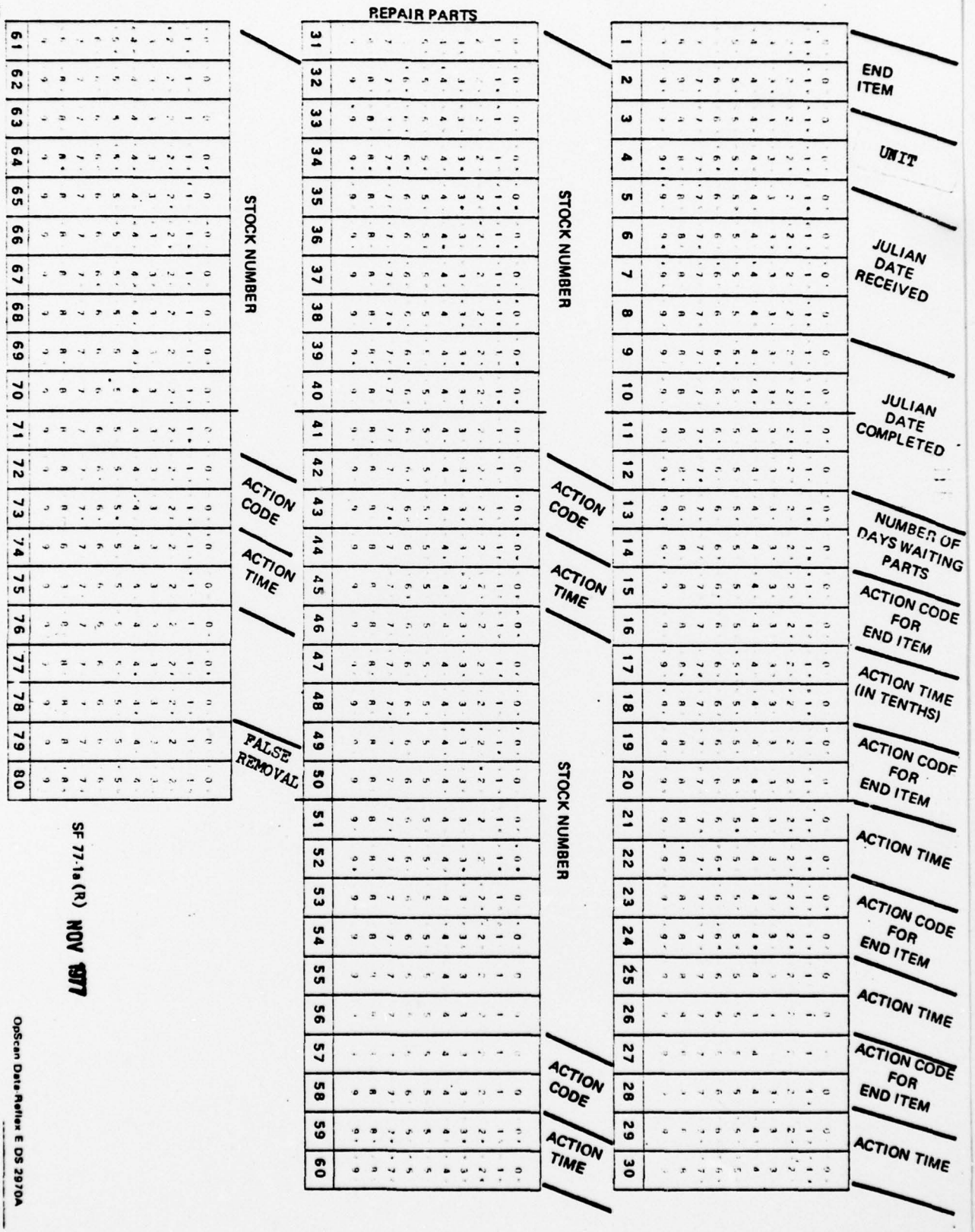
ACTION CODE

NUMBER	CODE	DESCRIPTION
01	A	Replaced
02	B	Adjusted
03	C	Repaired
04	E	Services (except aircraft)
05	F	Initial Inspection
06	G	Final Inspection
07	H	MWO
08	J	Tested
09	K	No ORF
10	L	Removed and Installed
11	M	Checked NRTS
12	N	Checked Not Repairable
13	P	Checked Serviceable
14	R	Removed
15	S	Installed
16	T	TB Compliance
17	U	ORF Exchange
18	W	Hour Meter/Odometer Change
19	X	Gun/Howitzer Tube Change
20	Y	ORF Not Stocked
21	ON	Modification by Replacement
9 in col. 79		False Removal

ACTION TIME CONVERSION CODE

MINUTES	TENTHS
1-6	01
7-12	02
13-18	03
19-24	04
25-30	05
31-36	06
37-42	07
43-48	08
49-54	09
55-60	10 (FULL HOUR)

FORM SF77-1


REPAIR PARTS
END ITEM
UNIT
JULIAN DATE RECEIVED
JULIAN DATE COMPLETED
NUMBER OF DAYS WAITING PARTS
ACTION CODE FOR END ITEM
ACTION TIME (IN TENTHS)
ACTION CODE FOR END ITEM
ACTION TIME
ACTION CODE FOR END ITEM
ACTION TIME
ACTION CODE FOR END ITEM
ACTION TIME
STOCK NUMBER
ACTION CODE
ACTION TIME
STOCK NUMBER
ACTION CODE
ACTION TIME
STOCK NUMBER
ACTION CODE
ACTION TIME
FALSE REMOVAL
SF 77-1a (R) NOV 1977
OpScan Data Reflex E DS 2970A